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ENVIRONMENTAL POLLUTION: EFFECT ON PEDESTRIANS WHILE WALKING IN URBAN STREET

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Abstract

Purpose: The reason for this study is because of observed difference in environmental condition in Lagos metropolis. The change is witnessed in environmental change arising from air, water and noise pollution mostly from increasing vehicle emissions in the State. This study has been conducted to analyze the environmental effects of pollution on pedestrians. Specific objectives are determine the air quality of the city at most populate headquarters of each of the 20 Local Government Areas of Lagos State, to examine the impact of pollution (air, water and noise) on pedestrians and assess various measures for reducing environmental pollution in the State.

Methodology: The use of Thermo scientific MIE pDR-1500 instrument was used to measure air quality index of the selected locations and survey was carried out with well-structured questionnaire to elicit information with the aid of incidental sampling technique on impact of pollution on pedestrians from 177 respondents.

Findings: Air Quality Index was shown with histogram chart where six out of 20 Local Government Areas are above the acceptable standard of pollution. There is rising cases of pollution in the State and very few Local governments were within acceptable range. One – Sample T-test showed that air pollution is majorly affecting pedestrians with t-value of 22.226 followed by noise with 19.643 and water with 5.529 respectively.

Conclusion and recommendations: The research concluded that, there is need to control the rising cases of pollution in the state and policies to tame air and noise pollution in the state should be adopted. Emission control strategies to be adopted with the existing ones can be in form of restricting hours of movement of vehicles to late at night to avoid human pollutant contact, encourage tree planting and rapid evacuation of environmental waste.

Keywords: *Pollution, Urban, Environmental, Pedestrian, Effect*

INTRODUCTION

Pedestrians are people moving from one place to another by foot (Oladejo, Oyadele and Adiamo, 2020). Walking as a means of movement in an urban environment has been encouraged to reduce congestion and improve physical well-being (Barton, Hine and Pretty, 2009). Benefits accruable to walking include reduction in number of deaths, reduction in cost of health care and no sickness guarantees lack of absenteeism from work. However, as man interacts with his immediate environment, environmental factors like air, water, noise, aerosol and unwarranted particles are unconsciously interfering to his well-being. Ioannis, Elisavet, Agathangelos and Eugenia (2020) defined pollution as harmful substances introduced into our environment which can affect human and other living organism. Pollutant can also be regarded as substance that reduces quality of an environment either in solid, liquid or gaseous state. UNEP (2009) observed that over 1 billion people have been affected by pollution all over the world. Children are more vulnerable and the death rate as a result of diseases from pollution is about 0.8 millions.

The source of poor air quality as found out by Amorim et al (2013) can be linked to transportation. This is because transport is at the centre of human activities as it provides access to job, tourism, education, market and tapping or exchange of resources (WHO, 2000). Furthermore, population of urban centres keeps increasing and same with means of mobility and consequently the generated emissions. According to HEI (2010) transport vehicles emit pollutants in form of carbon monoxide (CO), particulate matter (PM), formaldehyde, benzene, nitrogen oxides (NOx) and acetaldehyde which are negative substance(s) with negative impact on human and plant growth. On some street roads, especially in developing economy; aerosol, dusts and non-combustion emissions generated are all injurious to pedestrians' health. Apart from these, cooking at various centres in urban areas using fire wood and irrational burning of solid materials generate carbon monoxide which may reduce the air quality. Women were said to be much more exposed to indoor pollution because of their involvement in the cooking at homes.

Many of the studies about the effects of pollution on human health found correlations between exposure to traffic environment and its high positive effects on human health. Some of the effects as noted by (Finkelstein, et al 2004, Hoek et al, 2002, Hoffmann et al, 2007 and Tonne et al, 2007) are related to stroke, cough, shortness of breath, heart disease, atherosclerosis and death. Meanwhile, the deduction of these correlations is mostly based on hospital records and data from air quality monitoring stations. In order words, proper linkage of these diseases to pollution was vague. In an attempt to curb the menace of environmental pollution, some strategies have been adopted. Part of these strategies are increase in tax on emission, policies on the age of imported vehicles, planting of trees to absorb pollutant, construction of pedestrian channels and others. According to Bull (2003), the use of catalytic converter has been introduced to turn toxic and pollutants from combustion engines into less toxic pollutant by redox reactions. Greece controlled number of vehicles on street at rush hours based on the number plates to avoid pollution and congestion. Environmental Protection Act (EPA) has been developed by the United Nations but till date, the problem has not been totally eradicated (Eze et al, 2014). Therefore, this study has been set out to address the following objectives:

a) To determine the air quality of the city at most populated headquarters of each of the 20 Local Government Areas of Lagos State
b) To examine the impact of pollution (air, water and noise) on pedestrians and;

c) To assess various measures for reducing environmental pollution.

The research hypothesis in the context of the first objective is stated in null form thus:

a) The air quality is not different from the acceptable standardized quality in the metropolis
b) Pollution does not have impact on the pedestrians in the metropolis

The influx of migrants from other states in Nigeria apart from other parts of the world into Lagos State and increasing trend of car ownership necessitated this research. Though, pollutant may not been seen but clearly it is felt. Pedestrians feel inhale different oxygen in different areas and contact of pollutant with eyes and it perception from the smells at different locations are obvious. The significance of this study is to further understand the effect of environmental pollution on the environment of the study area with a view to developing strategies that can curtail it.

LITERATURE REVIEW

Fire and water are two major utilities for man on the planet earth. Fire is used for cooking, refinement, production and ignition of automobiles. However, water is used for digestion, production, cooling system and for clean ship of dirt. Concept of pollution started in 16th century from mining and contamination of natural environment came through deforestation, burning, agriculture and use of fossil fuels (Gabrielli, 2015). The natural environment has been altered due to activities of man. Transportation in particular is the cause of road construction, rehabilitation, exhaust emissions and other particulate matters. The means of mobility in modern days is necessity. This is because from production, distribution, consumption and disposition transportation is central to them all. The use of these vehicles comes with environmental pollution. This affects the general atmospheric condition in which human breath (Oladejo et al, 2020).

While theory provides fundamental assumptions on a phenomenon, the human-environment interaction theory cannot be accurately explained by one theory. Therefore, combination of theories like behavioural theory, environmental theory and health belief theory can be used to provide insight into the pedestrian-environmental pollution. Behavioural theory opines that if people are well informed, they can adjust their behavior to environment in a responsible manner. It was predicated on the fact that, knowledge creates awareness and awareness can change behavior (Akintunde, 2017). Theory of environment as expressed by Hines, Hungerford and Tomera (1987) expressed that, notion or intention of individual and attitude has a significant impact on how people react to environment. Environmental citizenship model proposed by Hungerford and Volk (1990) noted that, three stages of involvement of education in environmental matters include entry level, involvement level and skill or control level. The first is sensitivity about environment, second is commitment with in-depth knowledge and last is intention to act, control and correct anomalies. Health belief theory explained the perceived susceptibility to illness and anticipated severity of the consequence of illness (Ajzen, 2002). Then, how can we be better informed to change environmental pollution? What preventive and corrective measures are to be taken on effects of environmental pollution on human health? These are fundamental questions from these theories based on the considerations for pedestrians and environmental pollution. Each of the identified types of pollution is explained further.

Air quality has now been a major concern in booth developed and developing economy of the world. According to (Tilt, 2019, Plaia 2011 and Manisalidis, 2020) air quality is a condition in which the natural air and surrounding is free of pollutants such as smoke, gaseous impurities, dust and smog. This quality may vary per day and location depending on the activities that are going on there. Air pollution for example is caused by human intervention and natural phenomenon (Ghorani-Azam *et al*, 2016). One of the proponents of environmental pollution is behavioral change model or theory. It opines that, if society is well informed about their, environment; their attitude in the environment will change their behavior. In the context of environmental pollution, the damages occasioned by water contamination, air quality reduction and concomitant effects of noise pollution are known by the people, then the people in the environment will change their behavior to adapt against these effects (Hungerford, 1990). Hines, Hungerford and Tomera (1987) postulated environmental responsible behavior. This theory enunciated the fact that, intent influenced behavior.

The disposition of waste at odd hours causing air pollution or waste into the water channels are behavoural issues. Therefore, it suggests that, not only about the knowledge of the users of an environment but behavioral change in terms of intent of users to perpetrate prohibited acts. Peggy (1996) and Akintude (2017) diagrammatically showed the Environmentally Responsible Behaviour (ERB) in figure 1 below.
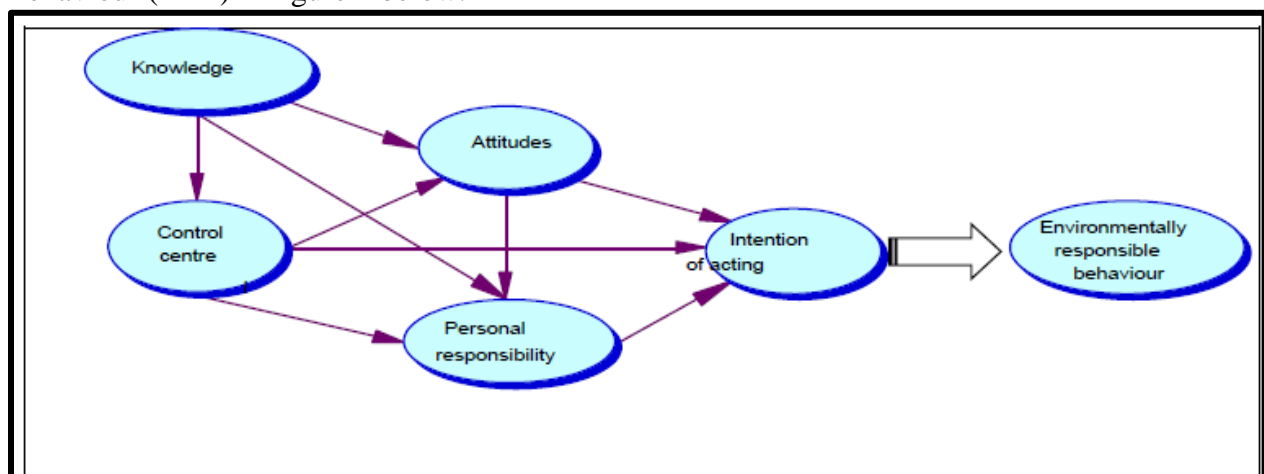
Source: Akintunde (2017)

The figure 1 explained that, a man's intention and action are influenced by his knowledge, control centre (which can be laws of the land), his attitude and personal responsibility. These combined will have a general effect of the environment.

Air pollution

Particulate, chemical reactions and emissions of gases are the sources of air pollution. According to HCWH (2020), air pollution is caused by both natural and human sources. The human activities that trigger air pollution are from the household, industry, transportation, agriculture and waste disposition. Air pollution can injure or cause diseases against human health which can lead to death. Long term exposure to outdoor or indoor air pollution contributed to 1.67 million annual deaths from heart attack, diabetes, cancer of the lungs and other lungs diseases in 2019 (State of Global Air, 2020). Fine particulate matter (PM2.5) can penetrate the lungs to distort

blood streams. There is correlation between exposure to dirty air and increase in mortality. HCWH (2020) carried out an experiment which conformed that, people are exposed to more diseases as they get in contact with air pollutants.

Bivina *et al* (2001) observed that air pollution also come from smoking sweeping, geological weathering, chipping of paints most in the cities. All these were claimed to have certain effects in the long run for the workers or people who smoke habitually. Amorin et al (2013) researched on the exposure of students who are pedestrians to a particular air pollutants carbon monoxide (CO). They made emphasis on how trees and route choice can be of advantage towards the effect the student's exposure to such air pollutants. We concluded that their findings are focused on air pollution among another environmental pollution. Chung et al (2019) worked on relationship between the pedestrians' street volumes and particulate matter as one of the air pollutants. The findings reveal that regression analysis shows that particulate matter concentrations are an indicator for the volume of pedestrians on the street. This is an implication that pedestrians take precaution of not walking when the particulate matter has high concentration to prevent been harmed by its effect.

Bereitschaft (2015) was able to build on research work of the relationship between the pedestrians' street volume and particulate. In their own case, they considered ambient concentration of fine particulate matter across some geographical areas. The outcome of their research reveals that 14 out of 25 variability in sidewalk particulate matter can be attributed to the background concentration of the particulate Matter. More so, their research support that of Chung et al (2019) that pedestrian's volume is inversely proportional to the concentration of the Particulate matter. It implies that pedestrians' volume becomes lower when the particulate matter concentration was comparatively high as vice versa.

Pitsiava et al (2000) conducted research on pedestrianization scheme and the researcher focus was to present the impact evaluation of the pedestrianization schemes on the environmental aspect. The findings reveal that majority of traffic and environmental problems are prominent in the interior part of the Urban Cities where man activities are being carried out. The pedestrianization scheme was able to improve emission of air pollutants generated from traffic among other benefits. Marshall (2009) carried out research on the interactions between exposure of pedestrians to air pollutants and neighborhood walkability. He as bale to estimate the concentration of nitric oxides (NO) and Ozone (O3) in the population size. The research identified neighborhood that do poorly for walkability and with higher tendency to be exposed to air pollution. The findings was able to open eyes to how we can curb the effect of air pollution on the poor in Urban cites whom are expected to get the burden of the pollution compare to the rich.

Kaur, (2005) conducted a research on pedestrian exposure to Particulate Matter 2.5, blackness of the particulate Matter, carbon monoxide and ultrafine particle counts along a major road. Particulate Matter exposure was established to be higher compare with that of afternoon and there is a significant difference in the exposure on the different sides of the road. No significance difference in pedestrians exposure to CO based on walking position, walking direction, canyon side or timing.

Noise Pollution based Publications

Noise is regarded as unwanted sound that constitutes harm to human beings. Noise are mostly generated from the brakes, drivers honking the horn, aircraft moving or taking off, drilling, surface road construction among others. Noise is responsible for admissions in hospitals and premature deaths in early year across Europe (Iberdroila, 2021). Noise used to affect not only human but also animals because it causes dysfunction in their breathing and breeding cycles. However, not all noise should be considered noise pollution. WHO defines noise as a sound that is above 65 decibels as noise pollution. It was said that, noise becomes harmful if it exceeds 75 (dB) decibels. Horn produced at 9dB and buses produce about 100dB.An aircraft produces between 130dB and more depending on type and age of the vehicles.

Franek et al (2018) work focused on the effect of noise pollution on the walking speed of pedestrians. He considered two noise pollution" one is annoying acoustical stimuli (traffic noise) and the other is relaxation noise (forest birdsong). The study justified those participants that listened to traffic noise do not like the route compare with participants that listened to relaxation noise (forest birdsongs). Besides pedestrian listening to traffic noise walk faster than those in control condition and those that listened to forest birdsong. Finally, the findings documented that is positive influence on listening to different forms of relaxative noise while walking rather than traffic noise.

King et al (2009) studied the pedestrians exposure to both noise and air pollution. They explore the possibility of reducing environmental pollutants through urban planning and designs. The result of the findings claim that optimal solution for minimal level of environmental pollution can be achieved by structural designs that segregate pedestrians and road traffic in Urban Cities.

Water pollution

Human makes use of water for drinking, cooking, berthing and cleaning. In all of these activities exposure to contaminated water can cause a serious negative effect to human health system. According to EPA (2021) algal, toxic substances and compounds flow in water which can pose danger to human health. Nitrate which is a compound in fertilizer used to enter into drinking water in rural areas and can cause rashes, liver illness or respiratory problems. Run off of water can cause bacteria to have their ways into untreated water and result into human health challenges. Parek, Khan and Srivastava (2020) observed the impact of pollution on water of Gharggar and realized it causes malaria, typhoid, jaundice, hepatitis and diarrhea to the people living in the vicinity of the river.

Kumar, Meena and Verma (2017) explained that contaminated water spreads and it goes deep to about 40m and 3.5km from abandoned factories. This has been the source of cancer, kidney problems, lungs diseases, skin challenges and liver problems. Sewage, industrial and domestic waste containing urine, faeces, dish washes and other decayed substances are directly flowing into the rivers, contaminating seafood consumed by the pedestrians in urban areas. Study by Kuma, Meen and Verma (2017) also pointed out that, rainfall is an agent of water pollution. Rain wash off surfaces with oil, other pollutants and deposit them into the water which may be used by people.

METHODOLOGY

The study area is the second most populous state in Nigeria. It was formerly the capital of Nigeria and haven of industries. Lagos has 20 Local Government Areas. Thermo scientific MIE pDR-1500 instrument was used to determine the Air Quality Index (AQI) of the Local Government Areas with aggregate values from Local Council Development Areas (LCDAs). The use of incidental sampling technique was adopted because of qualitative value of data needed from 180 respondents. The respondents are to respond on questions on type of pollution affected with as pedestrians in the state. Descriptive analysis in form of histogram was used to record various Air Quality Index aggregate of the Local Government in the State. Instrument of data collection and design requested for any type of pollution that has affected the respondent in the past, if they have ever been told by physician the cause of any health challenges linked to any type of pollution and methods they have seen or presumed to be the solution to environmental pollution. The responses were coded and analysed with the aid of SPSS version23.1. One Sample T-test has been used to assess the impact of identified pollution on the respondents.

RESULT AND DISCUSSION

Testing the air quality index across the various local governments with the instrument Thermo scientific MIE pDR-1500 showed that, the air quality in Lagos State needs corrective actions to mitigate the foreseeable danger. Out of the 20 Local governments, six (indicated with red) are above acceptable level of air quality. Kosofe, Ojo, Ikorodu, Mushin, Badagry and Apapa are the zones of Local Government Areas with red graph for environmental air pollution. However, Ajeromi-ifelodun, Ikorodu, Agege, Ifako ijaiye, Ati Osa, Epe, Ibeju Lekki, Surulere, Ikeja and Lagos Main land are above 50 but below 100 in the reading (yellowish in colour). Alimoso, Somolu, Amuwo-Odofin and Lagos Island are showing green line. This means that, these Local Government are within the international acceptable Air Quality Index (see figure 2).
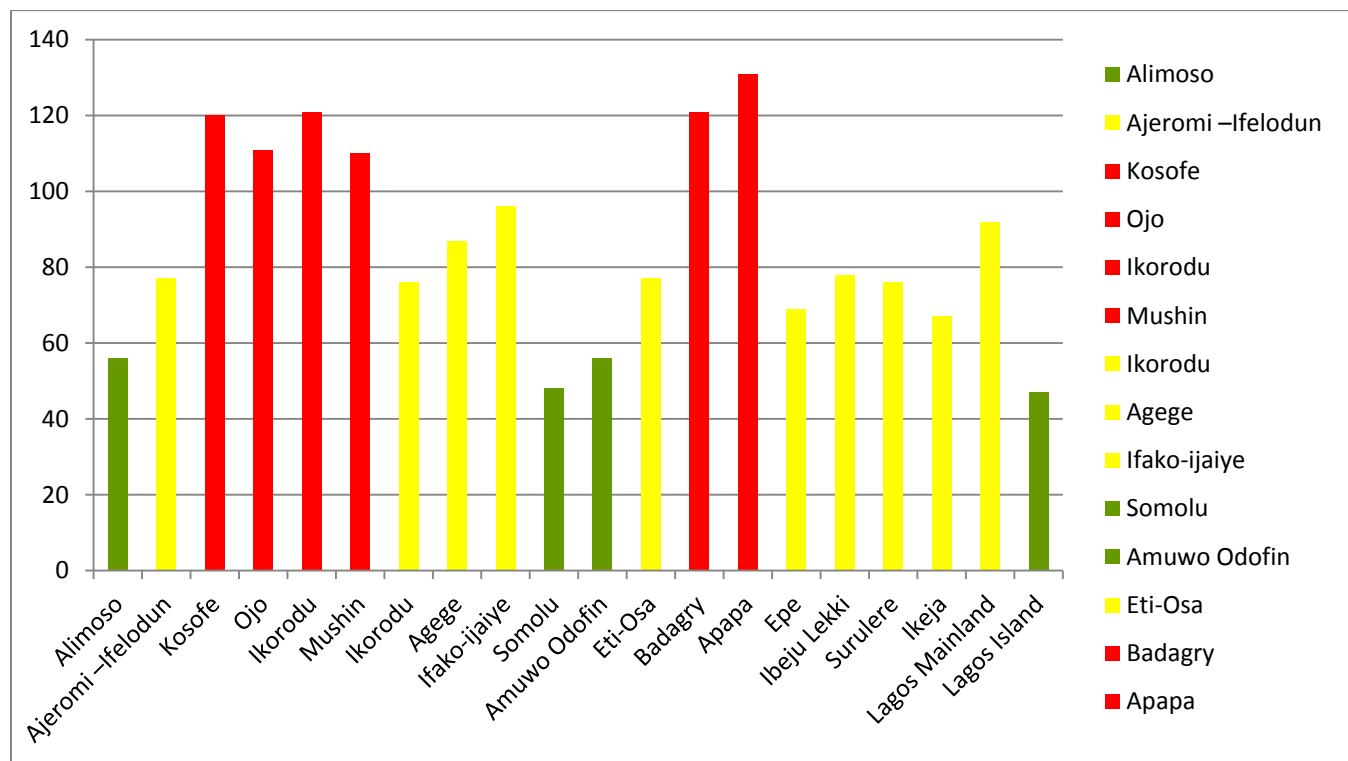
Source: author's data analysis (2021)

Respondents' answers were coded to elicit information on how they have been affected by pollutants in the study area. One sample T-test has been used to determine the various impacts as shown in the table 1 and 2 below:

Table 1: One sample Statistics

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
air	60	2.8000	1.02180	.13191
water	57	3.1228	4.26393	.56477
noise	60	2.0333	.80183	.10352

Source: Author's output (2020)

Table 1 shows the pollution contained in each pollution type from the responses from the respondents. Water pollution showed that three respondents did not answer some questions. However, major concern is on the sample T-test. In Table 2, all data were statistically significant with Sig. (2-tailed) <0.05. T-values represent various the contributions of each of the types of pollution in the study area. In this case, air pollution with t-value (21.226) is the major pollutant in Lagos metropolis, followed by noise pollution with value of 19.643 and the last one 5.529 for water pollution.

Table 2: One sample Test

One-Sample Test

	Test Value = 0					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
air	21.226	59	.000	2.80000	2.5360	3.0640
water	5.529	56	.000	3.12281	1.9914	4.2542
noise	19.643	59	.000	2.03333	1.8262	2.2405

Source: author's computation (2021)

The research showed that, there is high level of air pollution in Lagos State, Nigeria and closely followed by noise pollution and least is water pollution. Analysis of variance (ANOVA) has been used to assess various measures at reducing pollution in the study area. The ANOVA shows the result based on the ranking of interval data collected from the respondents. The identified measures are policy on environmental pollution regulation on imported vehicles, tax/fine placement on un-roadworthy vehicles, refuse dumping prohibition; tree planting and pedestrian walk way. Each of these was represented with acronyms as follows:

a) Pollution Reduction methods (PRM)
b) Regulation on imported vehicles (RIV)
c) Tax/Fine Placement   (TFP)
d) Refuse Dumping Prohibition (RDP)
e) Tree planting   TPT
f) Pedestrian walk-way barricade (PWB)

Model specification: PRM= f (b0 + RIVx$_1$ + TFPx$_2$ + RDPx$_3$ +TPTx$_4$ + PWBx$_5$)

Table 3: ANOVA analysis

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Regulation on imported vehicles	Between Groups	5.400	3	1.800	10.800	.008
	Within Groups	1.000	6	.167		
	Total	6.400	9			
Tax,Fine Placement	Between Groups	3.750	3	1.250	1.579	.290
	Within Groups	4.750	6	.792		
	Total	8.500	9			
Refuce Dumoing Prohibition	Between Groups	8.000	3	2.667	2.667	.142
	Within Groups	6.000	6	1.000		
	Total	14.000	9			
Tree Planting	Between Groups	.483	3	.161	.247	.861
	Within Groups	3.917	6	.653		
	Total	4.400	9			
Pedestrian Walkway Barricade	Between Groups	1.650	3	.550	.216	.882
	Within Groups	15.250	6	2.542		
	Total	16.900	9			

Source: Author's analysis (2021)

Table 3 above shows the analysis of data on strategies to reducing pollution in our environment. Of all the identified measures, regulation on imported vehicle is the most useable for pollution reduction purpose in the metropolis. Furthermore, it is only regulation on import that has the highest Fraction of 10,8 which is significant at $p<0,05$. Other identified variables are not statistically significant. However, the implication of some of the air pollution can be curbed from the source (vehicle).

CONCLUSION AND RECOMMENDATIONS

This research has been able to reveal that, the study area needs strategic pollution management as it keeps growing. Air pollution is really affecting the pedestrians and measures to curb it must be developed. It can be observed that growing pollutants with above 50 are many in the reading. Therefore, Lagos State government needs policy control measures and to tame the rising cases of pollution. Pollution and other contaminated materials can be tamed at the source.

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